

A revised subduction inception model to explain the Late Cretaceous, doubly vergent orogen in the pre-collisional western Tethys: evidences from the Northern Apennine

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Orogenic processes are widely demonstrated to be strongly controlled by inherited structures. The paleogeography of the converging margins, and the tectonic processes responsible for their configuration, will influence the location of subduction initiation, the distribution of deformation between upper and lower plate, the shape of the accretionary prism and of the subsequent orogeny, through controlling the development of single or doubly-vergent orogens, and, as a corollary, the modality of exhumation of metamorphosed units.

The “alpine age” collisional belts of the Mediterranean area are characterized by tangled architectures derived from the overlapping of several deformation events related to a multiphase, long history that comprises not only the collision of continental margins, but that can be regarded as an heritage of both the rifting-related configuration of the continental margins, and the subduction-related structures. The Northern Apennines is a segment of these collisional belts that originated by the Late Cretaceous-Middle Eocene closure of the northern branch of the western Tethys, and the subsequent Late Eocene-Early Oligocene continental collision between the Europe and Adria plates. Due to a different configuration of the paired Adria and Europe continental margins, inherited from a rifting phase dominated by asymmetric, simple-shear kinematics, the Northern Apennines expose a complex groups of units, referred to as Ligurian Units, that record the incorporation into the subduction factory of either fragments of the Ligure-Piemontese oceanic domain (i.e. Internal Ligurian Units), and various portions of the thinned Adria margin (i.e. External Ligurian Units), describable as an Ocean-Continent Transition Zone (OCTZ). The structural relationships between these groups of Units are crucial for the definition of the pre-collisional evolution of the belt and have been the subject of big debates in the literature, together with the location and orientation of subduction initiation.

We have reviewed the ages and characteristics of the tectono-metamorphic events recorded in both the External and Internal Ligurian Units. Deformation and metamorphism in the External Ligurian Units pre-dates the subduction-related metamorphism recorded in the ocean-derived Internal Ligurian Units. We thus propose that closure of the Ligure-Piemontese branch of the western Tethys occurred through a subduction that nucleated inside the OCTZ of Adria, instead of localizing at the boundary between the oceanic basin and the Adria margin, and developed a doubly-vergent prism fed firstly by both continental extensional allochthons and ocean-derived rocks from the OCTZ, and only after by rocks and sediments from the oceanic realm.

We believe that this revised location of the inception of subduction, and the subsequent pre-collisional architecture, considered as inherited from the rifting and the oceanic opening phases, allow reconciling most of the controversies on the geodynamic evolution of the Apenninic orogeny, prior to collision.